Market value of restocking and landscape in red-legged partridge hunting: a study based on advertisements

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ABSTRACT

Context

In Spain, the release of farm-reared partridges to hunt is increasingly used, despite being thought to affect sustainability of wild stocks and to reduce the need of natural habitats for game.

Aims

To explore the market value as a possible incentive for current management, we evaluated within a segment of the red-legged partridge hunting market whether the use of farm-reared birds (as opposed to wild stock) or the naturalization of landscapes are affecting hunts market price.

Methods

We considered estates that sell individual hunting days and contacted buyers through advertisements. We gathered all advertisements for the 2010 season in 4 top hunting magazines and 2 websites, and conducted a telephone survey to record price and associated characteristics of hunts. We looked for relationships between price and the characteristics of sold hunts using general linear models.

Key results

Hunts varied largely in price, but neither restocking nor naturalization of the landscape explained price variation, at least within our sample of estates. The absence of price difference between wild or released partridges could be reflecting the current difficulty to distinguish both kinds of products in the market.

Conclusions

Market forces alone might not be promoting the public interest of the sustainable use of wild stocks versus industrial hunting based on farm-reared birds.

Implications

If promoting conservation and sustainable use of wild stocks is considered a major goal of official institutions in charge of biodiversity conservation and game management, they should promote reliable ways of identifying estates selling wild or restocked partridges, and they should also evaluate benefits and costs associated to hunting farm-reared birds in relation to wild birds, to help internalizing them if necessary. A study of determinants of hunters demand would also help explaining variation in supply and market prices.

KEYWORDS

Alectoris rufa, Spain, farm-reared partridges, commercialization, market value, restocking, small game, hunting management.

INTRODUCTION

The red-legged partridge (*Alectoris rufa*) is a good example of game species with strong social and economic importance. This is a farmland species which has been traditionally (as is today) hunted in most of its distribution range, Southwest Europe. Within its range, this bird is most abundant in Spain (Blanco-Aguiar et al. 2003), where it is extensively hunted. Additionally, it is also frequently hunted in Portugal, France, Italy, or the United Kingdom (an introduced population, in the latter case) (Delibes 1972; Fontoura 1992; López-Ontiveros 1994; Bernabéu 2002; Martínez et al. 2002). In Spain, small game represents 98% of all animals hunted, and generates more average number of hunting days per hunter than big game. The estimated total amount that hunters spend on small game hunting is also greater than on big game (Ministerio de Medio Ambiente y Medio Rural y Marino [MARM] 2006). Partridges amount to a quarter of all small game animals harvested annually (MARM 2006) and are widespread in Iberian ecosystems, where they play a key role as prey of many Iberian predators (Calderón 1977; Herranz 2000; Duarte and Vargas 2001; Virgós and Travaini 2005).

In Spain, hunting estates can be managed for commercial or for non-commercial hunting (we considered hunting is commercial when the main aim of the organization is profitability). The high demand of red-legged partridge hunts has led to widespread management practices usually focused on increasing the availability of birds to be hunted. A currently common practice is the release of farm-reared partridges (González-Redondo 2004). Partridges released annually amounted to 350000 during the early 1980s, and are currently estimated between 3 and 6 million (Delibes 1992; Pérez-Pérez 1992; Garrido 2002; Martínez et al. 2002; González-Redondo et al. 2010). Although current numbers are not precise due to the alleged occurrence of illegal releases (Garrido 2002), it is interesting that these estimates are higher than the declared annual national harvest (3.3-3.5 million, MARM 2010). It is also known that releases have become relatively widespread (e.g. 38% of hunting estates apply for licenses to release red-legged partridges in the region of Castilla-La Mancha, Ríos-Saldaña 2010), although they are applied with very different intensity among areas and estates (Arroyo et al. 2012).

There is a concern among hunters and scientists alike about the spread of this technique (Delibes 1972; Garrido 2002; Blanco-Aguiar et al. 2008; Sokos et al. 2008). Negative consequences on wild populations of farm-reared partridge stocking have been highlighted in many scientific studies (Dowell 1992). These negative consequences include changes in

92 population genetic pool through hybridization (Barbanera et al. 2010; Blanco-Aguiar et al.
93 2008), overhunting of wild populations (Dowell 1992), lower survival and reproductive
94 success of farm partridges in the wild (Gortázar et al. 2000; Millán et al. 2001; Duarte et al.
95 2011; Casas et al. 2012), disease spread by farm-reared partridges (Gortázar et al. 2006;
96 Villanúa et al. 2008), and loss of important adaptive behavioural traits (Randi 2008). The
97 determinants of demand for partridge hunts are not precisely known, but farm-reared
98 partridges are widely viewed by hunters as being of lower quality than wild stock (Vazquez-
99 Guadarrama 2012; Vargas 2008), so it could be expected that market prices reflect this
100 preference.
101 On the other hand, Arroyo et al. (2012) showed that areas managed for commercial red-
102 legged partridge hunting retain more areas of natural vegetation compared to non-commercial
103 estates, and may thus have higher conservation value, as natural value of farmland areas
104 increases with the presence of natural vegetation (Halladay and Gilmour 1995; Blondel and
105 Aronson 1999; Olivero et al. 2011). However, it is not known whether this relationship
106 reflects a conscientious aim to favour partridges, as their densities are higher in areas of
107 mixed farmland with natural vegetation (Lucio and Purroy 1992; Fortuna 2002). Moreover,
108 the use of farm-reared partridges may theoretically relax the necessity of maintaining good
109 habitats to sustain wild populations, so the use of this technique may also have negative
110 consequences on the environment, beyond the impact on wild partridge populations, unless
111 habitat naturalization is also a driver of hunters demand.
112 We wanted to evaluate to what extent the use of farm-reared partridges in hunting estates or
113 the maintenance of natural landscapes are currently affecting hunts market price, to shed some
114 light on the commercial motivations for their inclusion in current management.
115
116 **STUDY AREA**
117 We centred our study in Spain, where hunting is allowed in 77% of the Spanish territory, and
118 88% of this area (29000 hunting estates) is organised in hunting estates that are privately
119 managed (MARM 2006). Thus, hunting management goals are set from a private point of
120 view. Owners of the hunting rights are most frequently individual persons (75% of the estates
121 in Castilla-La Mancha, Bernabéu 2002), although enterprises or associations are sometimes
122 promoters too. Owners of the hunting rights are not necessarily owners of the land, so land
123 management decisions may be taken by different persons than hunting management decisions.
124 More than one percent of the Spanish population (MARM 2006) and around 70000 foreign
125 hunters hunt every year in those estates (Reginfo 2008). From the economic movement that

hunting creates, approximately 88 percent corresponds to small game, which generates a higher average number of hunting days per hunter. Additionally, most foreign hunters visit Spain to hunt small game, and specifically red-legged partridge (Junta de Castilla y León 2000).

METHODS

In Spain, hunts may be self consumed by the owners of the hunting rights, or else sold. In the latter case, hunts may be sold for the whole season (or more than one season) to a group of hunters, or they may be sold as individual hunting days (with either an overall price or paying per animal shot) (Bernabéu 2002). We restricted this study to commercial estates that sell individual hunting days. The main commercialized modalities to hunt partridges are driven and walked-up shooting. In driven shooting, assistants beat the land to flush partridges and drive them towards a strategically arranged line of hunters. In walked-up shooting, hunters (with or without dogs) shoot the birds as they encounter them (Buenestado et al. 2009). We studied here both of those modalities.

Bernabéu (2002) indicated that fidelity was one of the reasons for hunting in particular estates, because small-game hunters usually bought hunting days in the same estates, season after season. Moreover, he said hunters usually got new contacts through friends, and thus fidelity or the word of mouth are basic for a big part of the hunting market (at least around 1997, when that study was conducted). However, some of the commercial hunts are advertised in hunting magazines or on the internet. Here, we considered only this part of the market, because nuances related to fidelity affecting prices could shade the effect of the characteristics we wanted to study. Thus, we considered the red-legged partridge market that use advertisements to put in contact sellers and buyers.

Data collection

We used a telephone survey among hunting sellers to gather prices and some management characteristics of driven shooting and walked-up shooting hunts. We collected contact data on hunting magazines and on the internet, gathering all individual hunts advertisements from 2 specialized webs (www.vivahunting.com and www.elcotodecaza.com), and the main 4 specialized magazines in Spain (Trofeo, Jara y Sedal, Federcaza and Caza Castilla La Mancha, issues of September, October and November 2010). Commercial hunts may vary in the number of birds that a hunter is allowed (or expected) to hunt, on the number of hunters taking part in a hunt, or (in the case of walked-up shoots) on whether it is possible to hunt

alternative game without additional cost. All these variables could affect price. Other complements (not considered in the study) can also affect prices. Therefore, we considered only 2 products for the study, fixing common values for some of those complements. As these values do not usually appear in advertisements, we asked to 3 experts (heads of hunting or hunting managers associations) for their opinion about what would be common values for these complements. First, we considered a driven shooting day for one person, being able to hunt up to 100 partridges without additional cost, and including usual individual staff (2 people) for the hunter, charge of firearms and lunch. This product did not include lodging. Second, we considered a walked-up shooting day for one person, being allowed to hunt up to 3 partridges without additional costs, including staff (1 people) for the hunter, but no charge of firearms, neither lunch nor lodging.

We gathered 117 different telephone numbers to contact sellers whose hunts could meet our requirements. Within the characteristics included in these usually brief advertisements, 12 out of 117 said that partridges were wild or genetically pure, 8 gave insight about landscape and 6 about the size of the group taking part in the hunt, showing that these characteristics are sometimes viewed by the seller as drivers of consumer choice. The other characteristics cited were the region where the estate was located (in 108 advertisements), the estate area (18), price (14), presence of game keeper (2), general quality (7), temporal availability to hunt (5), and the legal category of "intensive estate" (11). This latter variable relates to a legal permission in the estate to release farm-reared birds throughout the hunting season without numerical limits (Díaz-Fernández et al. 2012). Thus, with this last information, it is almost explicitly understood that farm-reared partridges are released, although only 2 of these 11 advertisements specifically stated also that partridges came from farms.

Telephone calls followed a fixed guide (Table 1). Information recorded was price, if farm-reared partridges were released in the estate where the hunt was going to take place, the maximum number of hunters that were going to participate in the same hunt, and the landscape. The latter variable was categorised as "mainly agriculture", "mixture" or "mainly naturalized landscape". For walked-up shooting hunts we also collected information on whether it was possible to hunt wild rabbit (*Oryctolagus cuniculus*) (the most important alternative small game species in the area) without additional cost (Table 1). From the 117 contacts attempted, we obtained 47 successful contacts, 29 providing information for driven shooting and 46 for walked-up shooting (28 were successful contacts for both modalities). Unsuccessful contacts were due to telephone numbers being wrong, to sellers not offering the product we required, to sellers not providing the data we required, or to all hunts being

already sold for the season in course (and thus the offer being closed). 82% of the final successful sample corresponded to hunting estates located in Castilla La Mancha (the most important hunting region for partridges in Spain, Ríos-Saldaña 2008), the remainder being distributed around Andalucía, Catalunya, Castilla y León, Extremadura and Madrid (Fig. 1).

Statistical analysis

We tested whether driven shooting hunt prices were explained by the maximum number of hunters taking part in the hunt, by the naturalization of the landscape in the estate or by both variables at the same time (Table 2). We did not test for the effect of releases as there were not enough sellers offering driven hunts of wild partridges (3 out of 29, Table 3). We also rejected to test the effect of the region where the estate is located (as indicative of income variability) in price due to the small sample size corresponding to all but one region (Table 3). We used a generalized model with the R function glm (R Development Core Team 2009) and a Gaussian distribution of errors, testing both linear and log-linear response functions. We assumed a variable would explain part of the hunt price when the analysis of variance (type III, with the R function Anova) gave a p value less than 0.05 for this.

Similarly, we tested whether the walked-up hunt price could be explained by the use of farm-reared partridges, by the maximum number of hunters taking part in the hunt, by the naturalization of the landscape in the estate, by the possibility of hunting wild rabbit without additional cost, or by different combinations of these variables (Table 2). We used the same type of models and criteria as for driven shooting hunts. Descriptive data on sample size, and mean price (± standard deviations) for variables studied are shown in Table 3 for discussion.

RESULTS

In the market we explored, our data showed that there was a large variation in prices of walked-up hunts (Fig. 2), but the price of a hunt was not explained significantly by any of the evaluated variables (Table 2): whether it consisted of wild or farm-reared red-legged partridges, landscape naturalization, the possibility of hunting wild rabbit without additional costs or the number of hunters taking part in the hunt (min=1, max=50).

For driven shooting hunts, we also found large variation in prices (Fig. 3). The offer of wild partridge hunts was scarce (3 out of 29 sellers in our sample). Exploration of means of this unbalanced sample did not suggest existence of price variation related to this (2717 euros vs 2781 euros, Table 3). Similarly, variation in hunts price was not significantly explained by

any of the analysed variables (Table 2): landscape naturalization or number of hunters taking part in the hunts, within the range recorded in our sample (min=1; max=20).

A summary table of the GLMs results is provided as supplementary material (Table S1).

DISCUSSION

Our results indicate that, at least in hunting estates that use advertisements on specialized journals or the internet as selling channels, the walked-up hunt price variation was not related to the use of farm-reared partridges. If hunting a wild red-legged partridge instead of a farm-reared one had higher value for hunters (as expected from their perceived higher quality; Vázquez-Guadarrama 2012, Vargas 2008, Delibes-Mateos et al. in press), when maximum agreed harvest is kept constant we would expect a higher price for a wild partridge hunting day, but we did not find this. One possible reason for this may be that releases may be perceived by hunters as a way to reduce harvest uncertainty. Lower quality would be thus compensated by lower uncertainty. This could explain the high value of farm-reared partridges in walked-up shooting hunts. Alternatively, an explanation for this may be a lack of trustworthy guarantee of the real origin of partridges when the hunter does not know directly the estate management or has not hunted previously there (which is the case of hunters that buy hunting days through the channels we are considering here). It has been pointed out that fraudulent selling of hunts with released partridges as if they were wild exists (Delibes 1992), although the extent of this practice is not known (see also Díaz-Fernández et al. 2012). This may reduce the expected effect of partridge wild origin on the hunt price, because hunters may assume the possibility of being cheated: whether consumers prefer wild or farm-reared partridges, the lack of guarantee on this characteristic reduces the possibilities of consumers to select the hunt in relation to their willingness to pay for this practice. Thus, it would be necessary to implement some way to allow hunters (and governmental agencies in charge of biodiversity conservation and game management) to unambiguously identify wild and farm-reared partridges, a recommendation also supported to avoid sanitary problems (Viñuela and Arroyo 2002). In relation to driven-shooting hunts, it is important to keep in mind that we were not able to test for price differences in relation to partridge origin given that sellers of wild red-legged partridge hunts were very few (3). Exploration of mean prices did not suggest price variation in relation to this characteristic, but our sample size limitation implies the need to be cautious on extending the same conclusion to this modality.

As stated above, the estimated total number of farm-reared partridges annually released in Spain lies between 3 and 6 million depending on the author. This large number of released

birds comes mainly from a small proportion of intensive estates, which have few legal restrictions for releasing unlimited numbers throughout the hunting season, and which provide mainly driven-shooting hunts (Arroyo et al. 2012). However, small-scale supplementation of wild stock with farm-reared birds is also widespread (Ríos-Saldaña 2002). The small number of sellers that offered hunts with only wild red-legged partridges in our sample (3 out of 29 in driven shooting, 15 out of 46 in walked-up shooting) agrees with a generalization of releases among estates, as reported in the above-mentioned studies. Additionally, it agrees with the perception of managers that releases are necessary to maintain profitability of commercial hunting (Authors, unpublished data). The lack of price difference between hunts in restocked vs wild stock estates, whatever the reason for it, suggests that the market is not giving incentives for changing the widespread practice of releasing. Future research could explore more specifically the interactions related to farm-reared and wild partridges.

Similarly, our results did not show any relationship between hunt price variation in our sample and the presence of natural habitats in the landscape. Hunting has been claimed to be associated with the retention of natural habitats in the UK (Tapper 1999, Robertson et al. 2001, Duckworth et al. 2003). Similarly, commercial red-legged partridge hunting estates in Central Spain seem to have a higher proportion of natural vegetation and a lower proportion of farmland than non-commercial ones (Arroyo et al. 2012). But reasons for this relationship are not clear, and other studies have led to varying conclusions on the role of commercialization as an incentive to manage natural habitats. A study of fee hunting of waterfowl on private lands in Oregon indicated that the financial return was an incentive for farmers to improve waterfowl habitat (Rasker et. al. 1991), while in Utah, less than 25% of the landowners who charged a fee for hunting improved actively wildlife habitats (Jordon and Workman 1989). In the case of red-legged partridge, one possible reason for the relationship between commercialization and more naturalized landscapes would be the possible hunter preference for more naturalized landscapes to hunt (willingness to pay more for these sceneries). However, the absence of effect of the naturalization of the landscape in the market price that we found in this work does not support that explanation, and implies that this characteristic of red-legged partridge hunting estates is probably not being managed to increase hunts market prices. Managers could be considering landscape as an indirect way to increase revenue, as landscape is associated to partridge abundance (Lucio and Purroy 1992; Fortuna 2002; Buenestado et al. 2008; Vargas et al. 2011), so a more naturalized landscape may result in more hunting days and thus more revenue, even if landscape does not increase hunts market price. Alternatively, commercial hunting estates could be located in areas where

other more profitable agrarian uses would be less productive, and thus the relationship of commercial hunting with landscape would not be a direct consequence of hunting management. Finally, managers could be managing habitat with goals different to revenue. Research on this issue would be interesting to understand the relationship between commercial hunting and habitat conservation that has been previously mentioned, and assess how long-lasting is this potential benefit for conservation attributed to hunting.

Globally, the absence of relationships in our results between hunts prices and any of our explanatory variables may also be attributed to our small sample size ($n_{driven} = 29$, $n_{walked\text{-}up} = 46$); if sample size was larger, statistical robustness of results would also be larger. However, our work while gathering data showed that the number of sellers who sell driven or walked-up hunting days through the internet or specialized journals in Spain is low (we found 117 advertisements selling one or both of them), and thus our sample size represents around a half of the whole universe of sellers. We therefore believe that our results are representative for this fraction of the market. Thus, we conclude that for this way of commercialization, naturalization of habitat or management related to game conservation do not strongly affect hunts price, although subtle effects may exist and not be statistically detected with our small sample size. Further studies should work on increasing the sample size and introducing alternative explanatory variables (e.g. the region where the estate is located, or the distance to population centres or other attractions) that may shed light on other factors explaining the large price variability between estates, although these studies will have to previously solve a methodological problem we faced: we found that the length of our questionnaire was in the acceptable limit for a telephone survey and thus, to obtain more data related to each hunt price in each estate, a different approach should be used. Finally, we have to take in mind that our sample only represents a minor part of the hunting market; therefore, although this study do not show any influence of the variables considered on hunts price, we cannot discard such effect in the rest of the market. Our study is just a first step in a largely unexplored topic. Further studies of the red-legged partridge hunting market should also consider the role played by fidelity and the word of mouth to contact sellers, the most widespread method, to clearly understand the current market value of management practices and the components of the red-legged partridge hunts price.

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455 Figure 1: Regional distribution of the red-legged partridge hunts we studied in 2010 in Spain
456 (location of 11% of them was not recorded).

457 Figure 2: Distribution of red-legged partridge walk-up shooting day prices (euro) for hunts
458 with (black) and without (white) releases, from the telephone survey. In 2010, and in Spain.

459 Figure 3: Distribution of red-legged partridge driven shooting day prices for hunts with
460 (black) and without (white) releases, from the telephone survey. In 2010, and in Spain.

461

462 Table 1. Information recorded on red-legged partridge hunts through telephone surveys in
463 2010, in Spain: Information asked and variables derived from those questions.

	Questions asked in the telephone call	Variables (units)
Driven shooting	How much does a red-legged partridge driven shooting hunting day cost, being permitted to hunt until 100 partridges? Including usual individual staff (2 people) for the hunter, charge of firearms and lunch. Not including lodging nor taking hunted birds home.	Price-driven (euros per hunt)
	Are partridges for hunting farm-reared or wild ones?	Releases-driven (yes/no)
	How many hunters, maximum, would take place in this hunt?	Hunters-driven (number of hunters)
	The area where the hunt would take place, is mainly agricultural, mainly naturalized, or a mixture of both?	Landscape (agriculture/mixture/naturalized landscape)
Walked-up shooting	How much does a red-legged partridge walked-up shooting hunting day cost, being permitted to hunt until 3 partridges? Including lunch, staff (1 person), but not including lodging or charge of firearms.	Price-walked up (euros per hunt)
	Are partridges for hunting farm-reared or wild ones?	Releases-walked up (yes/no)
	How many hunters, maximum, would take place in this hunt?	Hunters-walked up (number of hunters)
	The area where the hunt would take place, is mainly agricultural, mainly naturalized, or a mixture of both?	Landscape-walked up (agriculture/mixture/naturalized landscape)
	For the same price, wild rabbit is permitted to be hunted?	Allowed to hunt rabbit (yes/no)
Name (not family name) of the person interviewed		
Other relevant comments		

464

465 Table 2. Combinations of explanatory variables in the tested models explaining red-legged
466 partridge hunts price in 2010 in Spain.

	Hunters (number of hunters)	Landscape (agriculture / mixture / naturalized)	Releases (yes / no)	Rabbit (yes / no)
Models - driven shooting	x	x	-	-
	x	-	-	-
	-	x	-	-
Models - walked-up shooting	x	x	x	x
	x	x	x	-
	x	-	x	-
	-	-	x	-
	x	-	-	-
	-	x	-	-
	-	-	-	x
	x	x	-	x
	-	x	x	x
	-	x	x	-
	-	-	x	x
	x	x	-	-
	x	-	-	x
	-	x	-	x
	x	-	x	x

467

468

Table 3. Sample size and mean, standard deviation, minimum and maximum price for the different categories of the studied variables of red-legged partridge hunts and hunting methods in 2010, in Spain.

Variable	Category	Driven shooting-price					Walked-up shooting price				
		n	MEAN	STD. DEV.	MIN.	MAX.	n	MEAN	STD. DEV.	MIN.	MAX.
Releases	Yes	26	2736	965.4	1140	4500	31	279	100.8	100	500
	No	3	2716	957.0	1700	3600	15	248	114.3	100	500
Maximum number of hunters*	-	29	2734	947.4	1140	4500	46	269	105.1	100	500
Landscape	Mainly agriculture	3	2383	1037.2	1450	3500	5	239	93.2	100	330
	Mixture	15	2628	782.9	1140	3600	23	268	116.4	100	500
	Mainly naturalized	11	2974	1150.0	1440	4500	18	279	96.4	130	500
Rabbit	Yes	0	-	-	-	-	33	258	95.7	120	500
	No	0	-	-	-	-	13	296	125.9	100	500
Region	Andalucía	1	1600	0	1600	1600	1	350	0	350	350
	Castilla La Mancha	25	2725	882.8	1140	4500	39	268	107.0	100	500
	Castilla y León	0	-	-	-	-	2	350	70.7	300	400
	Catalunya	2	2755	1845	1450	4060	1	220	0	220	220
	Extremadura	1	4050	0	4050	4050	1	330	0	330	330
	Madrid	0	-	-	-	-	2	158	81.3	100	215

*Note that this row also corresponds to the basic summary statistics of the whole sample.